9.1 ANALYSIS OF ALTERNATIVES

WAC 463-42-645 Analysis of alternatives. *The applicant shall provide an analysis of alternatives for site, route, and other major elements of the proposal.*

9.1.1 Introduction

This section summarizes the alternatives that were explored during development of the Project. The range of alternatives considered included those that would reasonably accomplish the basic Project objectives while avoiding or lessening any potentially significant, negative impacts of the proposed Project. These include considerations of the Project location, overall size, choice of wind turbine design, turbine and access road locations, and use of alternative generating technologies. The Applicant has carefully considered and weighed all of these aspects of the Project and the proposed Project design reflects these considerations. Numerous changes to the proposed Project were made to address these and other considerations.

9.1.2 Site

The choice of the proposed Project site reflects consideration of a variety of factors, including quality of the wind resource, access to existing high voltage transmission lines with adequate outlet capacity, site accessibility, compatibility of surrounding land uses, landowner receptivity to leasing of land for wind power production, potential visual impacts, and environmental factors such as the presence of rare or endangered species or critical habitat. Compared to conventional thermal power plants, wind power projects have significantly higher capital costs per MW of installed capacity, but no fuel costs. Wind power projects also are generally smaller in terms of rated capacity than thermal power plants.

This has two significant implications for the choice of sites for a wind power project. First, wind power projects must be located where the wind resource is adequate to produce the highest net capacity factor possible. Because wind is by nature intermittent, capacity factors at even the best wind power sites are much lower than for typical thermal plants (30%-40% vs. 85%). Second, wind power projects must be located near existing high voltage transmission lines with adequate outlet capacity. All central station power plants must interconnect to the grid, however the high capital costs of constructing many miles of new transmission lines is generally prohibitive for wind power projects. In contrast, some large thermal plants are able to incorporate these higher capital costs for interconnection by virtue of their larger size and lower overall capital costs per MW of installed capacity.

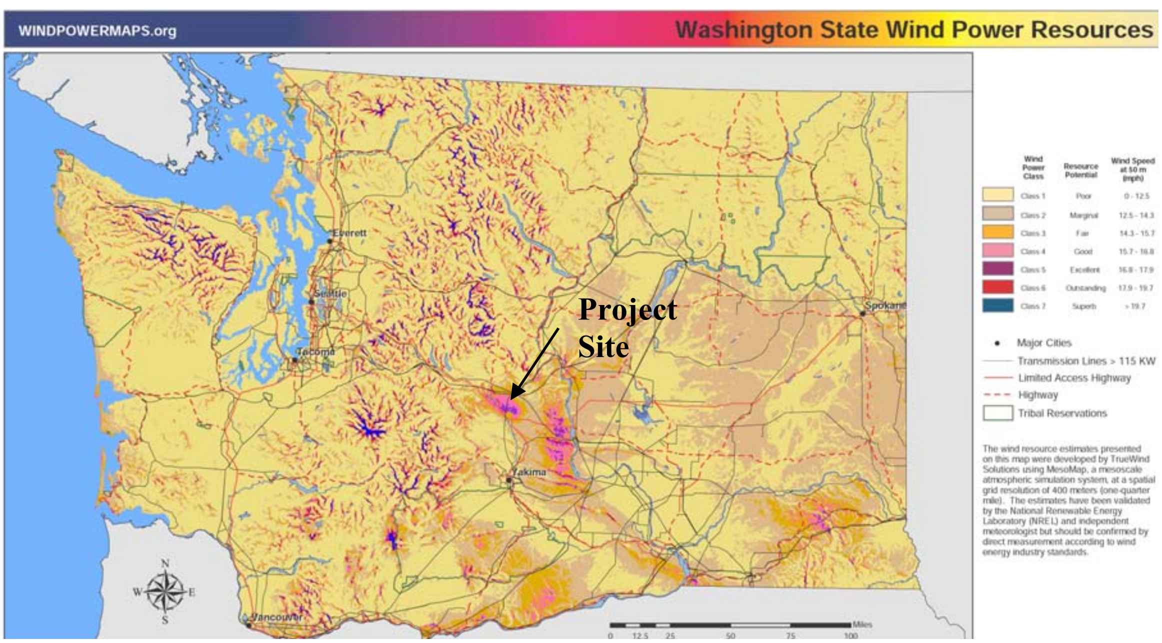
9.1.2.1 Wind Resource

Unlike conventional thermal power plants which can transport fuel to the desired power plant location, it is not possible to transport or direct the wind resource to a particular location. Nature dictates the abundance and distribution of wind resources. Developers must therefore go to where the wind resource is located. The amount of electricity that can be generated by wind is a function of the cube of the wind speed. This means that very small changes in average annual wind speeds at a proposed site translate into very large changes in energy production. For example, a two mile per hour (MPH) difference in annual average wind speed can result in 15% difference in annual electric energy production.

While it is possible to generate electricity at sites with lower wind speeds, the combination of current market prices for electricity in the Pacific Northwest and the efficiency of today's wind turbine technology generally require wind developers to choose sites with average annual wind speeds in excess of 16 to 17 miles per hour (MPH.) Sites with lower wind speeds would have net capacity factors below 30%, which would result in a price for the electricity produced above what the market will currently bear.

In Washington, the choice of potential wind power project sites is severely limited by the lack of sites with adequate wind resource potential to produce electricity at competitive prices. Compared to other states, Washington is ranked in the bottom tier in terms of wind energy potential (Pacific Northwest Laboratory, 1991.) Figure 9.1.2-1 shows a wind resource map of Washington State, based on a model developed by True Wind Solutions, that is commonly used by wind developers to aid in the identification of potential sites. Those areas shaded in purple are the areas that are predicted to have a wind resource adequate for producing energy at competitive prices (Class 5). Long-term ground based measurements are necessary to confirm the wind resource in these areas. Practical experience suggests that this map and model it is based on tends to overestimate the abundance of sites with Class 5 winds. It should also be noted that many of the areas that the map suggests have Class 5 winds are not suitable for wind power development due to site inaccessibility (e.g. Cascade mountaintops) or incompatible land uses (e.g. the Yakima Firing Range.)

Figure 9.1.2-1 Washington State Wind Speed Map



The proposed Project site has a proven wind resource suitable for producing electricity at competitive prices. Measurements were taken at the site for over two years in the mid-1990's by Kenetech, a wind energy developer, and that data is now publicly available from the National Renewable Energy Laboratory (NREL.) The Applicant has also erected nine new meteorological towers around the proposed site and has been gathering wind data since late 2001. This rich wind data set allows accurate estimates of energy production to be made with a high degree of confidence.

9.1.2.3 Access to Transmission Capacity

The second driving factor in identifying a viable site for a wind power project is access to existing transmission lines with adequate outlet capacity. As explained above, wind power projects generally cannot absorb the capital cost of constructing tens of miles of new transmission lines to interconnect with the grid. Again, this is due to their generally smaller size and higher overall capital costs per MW of installed capacity. The proposed site is crisscrossed by six sets of high voltage transmission lines, and several of these lines have adequate capacity and are of an appropriate voltage (230 kV) for a project of this size (MW.) By choosing a site where direct interconnection is possible, many environmental and visual impacts can be avoided. The choice of transmission route is discussed in greater detail in Section 8.2, 'Criteria, Standards and Factors Utilized to Develop Transmission Route'.

9.1.3 Project Size

The proposed Project size (181.5 MW) reflects several important criteria, including: economies of scale, the fixed or non-linear costs of interconnection and permitting, and market demand for larger projects with concomitantly lower prices. While the single largest cost for a wind power project is the wind turbine generators, for which pricing is largely linear, other costs are non-linear, such as the cost of the substation and interconnection, the cost to conduct the extensive studies required for permitting a project and the costs of the permitting process itself. By spreading these costs over a larger project, the cost per MWh of electricity produced is driven down.

It is widely recognized that the Pacific Northwest faces a growing need for electricity in the medium and long term. Recent reports from the Northwest Power Planning Council (NWPPC) and the draft Integrated Resource Plans of several regional utilities, including Puget Sound Energy and Pacificorp, provide evidence of this need for additional power and for the need to diversify the region's power supply away from its current reliance on the highly variable output of hydroelectric dams. Meeting this demand growth will require the installation of significant new generating capacity. In order for the region's power supply to be adequately diversified, it is essential that this new generation capacity not be entirely of one particular source (e.g. natural gas.) These macro conditions are leading regional electrical utilities to seek new and diversified sources of energy. Thus there is currently growing market demand for large power projects with competitive energy prices. The cost savings resulting from a larger project size are passed along in the form of lower wholesale power prices, which will help the state and region meet the growing demand for affordable and non-polluting power.

9.1.4 Wind Turbine Generator Design and Size

As described in Section 2.3.6, 'Wind Turbine Generators and Towers', the types of wind turbine generators being considered for this Project are all MW-class, three-bladed, upwind designs with proven track records. The Applicant has already devoted considerable resources to evaluating various turbine technologies and suppliers and the final turbine selection will be driven by several considerations, such as reliability, efficiency, and economics factors. All of the leading turbine vendors under consideration for this Project utilize similar turbine designs. The ultimate choice will thus be largely a question of the efficiency of the wind turbine generators in terms of cost per MWh of electricity produced. This is a primarily a factor of the site's meteorological characteristics, e.g. wind speed, distribution and shear, and the cost of the various turbine models relative to their output (which is itself a function of the turbines' individual power curves and the wind distribution at the site.)

The choice between larger or smaller wind turbines essentially boils down to a larger number of smaller machines vs. a smaller number of larger machines, as the output of a wind turbine is a function of its Rotor Swept Area (RSA). The larger the RSA is, the greater the annual output will be. The choice of MW-scale turbines, as are proposed for this Project, is intended to generate the most electricity at the lowest cost with the least overall impact on the surrounding area. The choice of a smaller number of large machines result in fewer foundations being excavated and a smaller number of FAA-required lights on the entire Project.

9.1.5 Turbine and Access Road Locations

The location of the wind turbine generators within the overall Project is dictated by four main factors, wind resource, accessibility, landowner preferences, and avoidance of sensitive areas. The proposed locations of the wind turbines and access roads are based on these factors. Wind turbines must be located on exposed ridge tops where the wind speeds are optimal. The Applicant's ability to negotiate lease agreements with individual landowners influences which ridge tops are potential candidates for wind turbines, and those landowners may have preferences regarding the precise location of wind turbines and access roads on their land. Finally, the extensive environmental studies conducted by the Applicant have identified those areas where construction of wind turbines and accompanying access roads will create the least environmental impacts to habitat and wildlife.

The Applicant has proposed to make use of existing access roads to the maximum extent practicable. By doing so, the overall area that will be permanently disturbed by the Project is minimized, as are environmental impacts. The Applicant has proposed access road locations that avoid sensitive habitat areas such as riparian zones, forests and wetlands. Nearly half of all the access roads proposed for the Project are existing roads that will be upgraded (10 miles out of a total of 23 miles) as show in Exhibit 1, 'Project Site Layout'.

9.1.6 Alternative Generating Technologies

The Project is designed to be a state-of-the-art wind power project that will produce affordable, renewable, pollution-free electricity to help meet the region's growing need for power. The Project's output will be sold in the competitive regional wholesale energy market.

9.1.6.1 Criteria

The choice of wind turbine generators vs. other generating technologies for the Project is based on several factors, including:

- Contribution to regional resource diversification;
- Ability to meet the growing regional demand for renewable energy;
- Environmental attributes of the technology;
- Ability to offer stable long term pricing; and
- Economics of wind energy vis-à-vis other renewable energy technologies.

9.1.6.2 Contribution to Regional Resource Diversification

The region currently is heavily reliant on hydropower and the vast majority of new power plants proposed in the region are gas-fired plants. Wind energy currently accounts for less than 2% of the region's total energy production capacity. By adding additional wind energy capacity, the Project will contribute to regional resource diversification. A recent study of the implications of alternative generating technologies for the Pacific Northwest by the RAND Corporation found that the addition of new renewable resources would produce significant environmental and economic benefits for the region (Pernin et al, 2002.)

9.1.6.3 Ability to Meet the Growing Regional Demand for Renewable Energy

The recent passage of Washington's Omnibus Energy Bill (RCW 19.29A.090) has prompted the state's major utilities to offer their customers voluntary green power programs. The growing popularity of these green power-marketing programs demonstrates the public's support for moving toward more sustainable, renewable energy sources. These factors, combined with a desire to reduce current reliance on hydroelectric power through resource diversification, are leading regional utilities to seek new renewable resources.

9.1.6.4 Environmental Attributes of the Technology

Wind turbine generators produce no air emissions, consume no water for cooling, result in zero wastewater discharges, require no drilling, mining or transportation of fuel, and produce no hazardous or solid wastes. Numerous studies have shown that the life cycle environmental attributes (total energy and resources consumed to build and operate vs. energy produced) of wind energy projects are highly favorable compared to other generating technologies (see Section 3.5, 'Energy and Natural Resources'.)

9.1.6.5 Ability to Offer Stable Long Term Pricing

Because wind energy does not rely on volatile fuel prices (e.g. natural gas plants) or highly variable annual snowmelt conditions (e.g. hydroelectric dams), the energy produced by wind power projects benefits from stable, predictable, long term pricing. The main cost associated with generating wind energy is the capital cost of the turbines themselves, which is fixed at the time of construction and not therefore subject to fluctuations. The power from this Project will be sold under a long-term contract which guarantees stable prices for years to come.

9.1.6.6 Economics of Wind Energy Vis-à-Vis Other Renewable Energy Technologies

Wind generated electricity is far less expensive than solar photovoltaic or fuel cell electricity on a cost per MWh produced basis. Hydroelectric dams and geothermal plants are the only renewable energy technologies that can compete with wind on a cost per MWh basis. New sites for major hydroelectric dams are not readily available in the Project area, and their potential impact on imperiled native salmon runs is a growing concern. Environmentally suitable geothermal resources adequate for cost-effective power production are also not readily available in the area. Wind is thus the most cost effective renewable technology for the Project area under current conditions.

9.1.6.7 Likely Alternative

The Applicant is focused on the development of renewable energy projects, and is not in the business of developing fossil fuel power plants. However, based on the types of power plants built in the region over the past several years, and the other power plants currently proposed or under review, it appears that a gas-fired power plant would be the most likely alternative to the wind power project proposed by the Applicant. A gas fired power plant, whether conventional or combined cycle, would have the following disadvantages compared to the proposed wind power Project.

9.1.6.8 Resource Diversity

As described in Section 9.6.1 above, the vast majority of new power plants proposed or built recently in the region are gas-fired. The region currently runs the risk of moving from a system that is overly dependent on hydroelectricity to a system overly dependent on natural gas. Natural gas prices are subject to significant price swings and are currently escalating. As the region's dependence on natural gas increases, the negative effects of a gas price shock are exacerbated.

9.1.6.9 Environmental Impacts

Gas-fired power plants, while significantly cleaner than coal fired plants, have many negative environmental impacts. Major categories of direct impacts include:

- Use and discharge of large amounts of water for cooling;
- Emission of criteria air pollutants such as SO_x and NO_x (these impacts are described in greater detail in Section 3.2, 'Air'); and
- Emission of greenhouse gases such as CO_2 (these impacts are described in greater detail in Section 3.2, 'Air').

Major indirect impacts include degradation of land and habitat and the greenhouse gas emissions associated with drilling and transporting natural gas. The potential for fire, explosions, chemical releases and other industrial accidents are also greater for gas-fired plants than for wind power projects.

9.1.7 Conclusion

For these reasons, the choice of wind turbine technology over gas turbine technology presents clear benefits both for the environment and the region's electric customers.